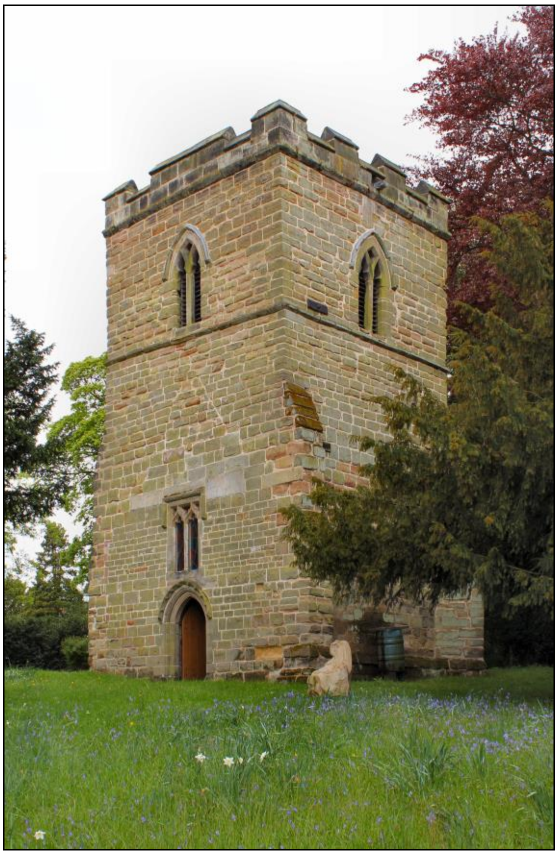
THE BELLFRAME
OLD CHURCH (ST MICHAEL)
BRAMCOTE
NOTTINGHAMSHIRE

SURVEY, RECORDING, AND TREE-RING ANALYSIS OF TIMBERS



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SURVEY, RECORDING, AND TREE-RING ANALYSIS OF TIMBERS FROM THE BELLFRAME OF THE OLD CHURCH (ST MICHAEL), BRAMCOTE, NOTTINGHAMSHIRE

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SUMMARY

Dendrochronological analysis undertaken on samples taken from timbers of the bellframe at this church resulted in the construction and dating of two site sequences. Site sequence BRCCSQ01 contains four samples and spans the period AD 1504–1586 and site sequence BRCCSQ02 contains six samples and spans the period AD 1393–1586. Interpretation of sapwood suggests felling of timbers utilised in *c* AD 1590.

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INTRODUCTION

The old church of Bramcote, located about 8km west of the city of Nottingham (Figs 1 & 2), is thought to date from the fourteenth century. Once consisting of nave, chancel, porch, and tower, only the tower now survives. The church was abandoned in AD 1861 with the nave, chancel, and south porch being demolished the following year (http://southwellchurches.nottingham.ac.uk/bramcote-old-church/hintro.php).

The bellframe

The oak bellframe for three bells is of queen-post, short headed design, Pickford Group 3.E (Fig 3). It is of one build, though there are some later replacements of timber (Fig 4). All joints are pegged except for the later work.

Short-headed frames are now extremely rare in Nottinghamshire, with this frame and those at Ratcliffe on Soar and Lambley (all Pickford Group 3.E) being the only queen posted ones remaining. Carlton on Trent is also a short-headed frame but of king posted type (Pickford Group 3.B).

Some of the timbers of the Bramcote frame have unused mortises and there are two possible explanations for this:

1. The timber is reused, from a previous king posted frame

2. The disused mortise is symmetrical with the one the other face of the post, so it may actually show that the frame was originally planned as a king post frame, but the carpenter changed his mind and built a queen posted frame.

As this timber does not appear to be substantially different from the rest of the queen posts, I am inclined towards the latter explanation.

One transom is dated 1829 and it is clear that this is a later replacement as it does not fit comfortably in the cut-outs on the truss braces. Associated with this are transom braces between each pair of outer pits, nailed to the braces, these being attempts to stabilise the frame from sideways rocking. There is also an iron bar through the centre of each truss, again attempts to stabilise the frame.

The frame may date from the late-sixteenth century, and may have been built when the treble (and possibly second) were recast in AD 1600.

The bells

The bells that were originally in the frame were removed in AD 1861, and recast by Taylors of Loughborough and then installed in the newly built church of St Michael. The old bells were inscribed:

Treble. GOD SAVE THE CHVRCH 1600 [40]

2. + IHESVS BE OVR SPEED [40]

TENOR. THOS HEDDERLY FOUNDER. WM. BURTON C. W. 1750

[BADGE NUMBERS ARE TAKEN FROM CHURCH BELLS OF NOTTINGHAMSHIRE, PART 1]

Physical data:

	Diameter	Weight (cwt.qr.lb)
Treble.	24”	2.1.21
2.	27”	3.1.6
Tenor.	28.75”	4.2.4

[Data from the John Taylor Bellfoundry Archive].

The treble and second bells were cast by Henry II Oldfield of Nottingham, possibly at the same time. The tenor was cast by Thomas I Hedderly, also of Nottingham.

PRINCIPLES OF TREE-RING DATING

Tree-ring dating relies on a few simple, but fundamental, principles. Firstly, as is commonly known, trees (particularly oak trees) grow by adding one, and only one, growth-ring to their circumference each, and every, year. Each new annual growth-ring is added to the outside of the previous year’s growth just below the bark. The width of this annual growth-ring is largely, though not exclusively, determined by the weather conditions during the growth period (roughly March to September). In general, good conditions produce wider rings and poor conditions produce narrower rings. Thus, over the lifetime of a tree, the annual growth-rings display a climatically determined pattern. Furthermore, and importantly, all trees growing in the same area at the same time will be influenced by the same growing conditions and the annual growth-rings of all of them will respond in a similar, though not identical, way.

Secondly, because the weather over any number of consecutive years is unique, so too is the growth pattern of the tree. The pattern of a short period of growth, 20 or 30 consecutive years, might conceivably be repeated two or even three times in the last one thousand years. A short pattern might also be repeated at different time periods in different parts of the country because of differences in regional micro-climates. It is less likely, however, that such problems would occur with the pattern of a longer period of growth, that is, anything in excess of 60 years or so. In essence, a short period of growth, anything less than 50 rings, is not reliable, and the longer the period of time under comparison the better.

The third principle of tree-ring dating is that, until the early-to mid-nineteenth century, builders of timber-framed houses usually obtained all the wood needed for a given structure by felling the necessary trees in a single operation from one patch of woodland or from closely adjacent woods. Furthermore, and contrary to popular belief, the timber was used "green" and without seasoning, and there was very little long-term storage as in timber-yards of today. This fact has been well established from a number of studies where tree-ring dating has been undertaken in conjunction with documentary studies. Thus, establishing the felling date for a group of timbers gives a very precise indication of the date of their use in a building.

Tree-ring dating relies on obtaining the growth pattern of trees from sample timbers of unknown date by measuring the width of the annual growth-rings. This is done to a tolerance of 1/100 of a millimetre. The growth patterns of these samples of unknown date are then compared with a series of reference patterns or chronologies, the date of each ring of which is known. When a sample "cross-matches" repeatedly at the same date against a series of different relevant reference chronologies the sample can be said to be dated. The degree of cross-matching, that is the measure of similarity between sample and reference is denoted by a "*t*-value"; the higher the value the greater the similarity. The greater the similarity the greater is the probability that the patterns of the samples and references have been produced by growing under the same conditions at the same time. The statistically accepted fully reliable minimum *t*-value is 3.5.

However, rather than attempt to date each sample individually it is usual to first compare all the samples from a single building, or phases of a building, with one another, and attempt to cross-match each one with all the others from the same phase or building. When samples from the same phase do cross-match with each other they are combined at their matching positions to form what is known as a "site chronology". As with any set of data, this has the effect of reducing the anomalies of any one individual (brought about in the case of tree-rings by some non-climatic influence) and enhances the overall climatic signal. As stated above, it is the climate that gives the growth pattern its distinctive pattern. The greater the number of samples in a site chronology the greater is the climatic signal of the group and the weaker is the non-climatic input of any one individual.

Furthermore, combining samples in this way to make a site chronology usually has the effect of increasing the time-span that is under comparison. As also mentioned above, the longer the period of growth under consideration, the greater the certainty of the cross-match. Any site chronology with less than about 55 rings is generally too short for satisfactory analysis.

SAMPLING STRATEGY

In 1994, 12 core samples were taken from the timbers of this bellframe. Each sample was given the code BRC-C and numbered 01–12, with the results reported at that time. As part of the recent Southwell Churches History Project, the data from this site has been re-analysed to present standards and results reported in this more up to date format. The location of all samples was noted at the time of sampling and have been marked on Figures 5–9. Further details relating to these samples can be found in Table 1.

ANALYSIS & RESULTS

In 1994, all samples had been prepared by sanding and polishing and their growth ring widths measured. Following present guidelines, one of the samples, BRC-C08, has too few growth rings to make secure dating a possibility and so was not re-analysed. The remaining 11 samples were compared against each other at which point ten of these matched to form two groups.

Firstly, four samples matched each other and were combined at the relevant offset positions to form BRCCQ01, a site sequence of 83 rings (Fig 10). This site sequence was then compared against a series of relevant reference chronologies for oak where it was found to match consistently and securely at a first-ring date of AD 1504 and a last-measured ring date of AD 1586. The evidence for this dating is given by the *t*-values in Table 2.

Secondly, six samples matched each other and were again combined at the relevant offset positions to form BRCCSQ02, a site sequence of 194 rings (Fig 11). This site sequence was found to span the period AD 1393–1586 when compared against the reference material. The evidence for this dating is given by the *t*-values in Table 3.

Attempts were then made to date the remaining ungrouped sample (BRC-C03) by comparing it individually against the reference chronologies but no secure match was noted and this sample remains undated.

INTERPRETATION

Tree-ring dating has successfully dated ten samples (Fig 12). Unfortunately, none of the dated samples retained complete sapwood and so an absolute felling date cannot be given. However, four of them had come from timbers which did have complete sapwood but some of these softer, outer rings had been lost during the sampling process. The number of lost rings were estimated for two of these samples (BRC-C01 and BRC-C05) as being only three or four rings. Both of these samples have the last-measured ring date of AD 1586 giving an estimated felling date for the two timbers represented of *c* AD 1590. Estimated number of lost rings for the other two samples from timbers with complete sapwood are not known.

Four of the other dated samples have the heartwood/sapwood boundary ring, which in all cases is broadly contemporary and suggestive of a single felling. The average heartwood/sapwood boundary ring date is AD 1563, allowing an estimated felling date to be calculated for the four timbers represented between the range AD 1578–1603, consistent with these timbers also having been felled in *c* AD 1590.

The other four dated samples do not have the heartwood/sapwood boundary ring and so estimated felling date ranges cannot be calculated except to say with last-measured heartwood ring dates ranging from AD 1490 to AD 1559 it is possible and extremely likely that these timbers were also felled in *c* AD 1590.

The felling date range has been calculated using the estimate that 95% of the mature trees in this region have 15–40 sapwood rings.

DISCUSSION

The dendrochronology has shown that the bellframe at Bramcote old church utilises timber felled in *c* AD 1590, with construction likely to have followed shortly after. Some of the beams have empty mortises suggesting, either the use of reused timber within the frame or alternatively, demonstrate a change in design between the cutting of the mortises and construction. With the tree-ring dating showing all sampled timbers are likely to be coeveal there is no support for the incorporation of reused timber which may add weight to suggestion that the empty mortises demonstrate a change in design.

The frame had previously been stylistically dated to the late-sixteenth century, with the suggestion being that it might date to the recasting of the treble and possibly the second bell (AD 1600). Although, on the evidence of the tree-ring dating, the frame is perhaps ten years earlier than the bell/s it is likely that they belong to the same programme of work, with the bells cast specifically for the new frame, perhaps when funds were available.

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ACKNOWLEDGEMENTS

The Laboratory and George Dawson would like to thank Professor John Beckett and Dr Chris Brooke for the information on the Southwell and Nottingham Church History website. Dr Brooke also supplied the photograph used on the cover of this report. The drawings of the bellframe were produced from a visit in 1991 and are as accurate as the incomplete measurements taken at that time; the later additions are not shown other than the replacement transom

Table 1: Details of samples taken from the bellframe at the Old Church (St Michael), Bramcote, Nottinghamshire

Sample number	Sample location	*Total rings	**Sapwood rings	First measured ring date (AD)	Last heartwood ring date (AD)	Last measured ring date (AD)
BRC-C01	South head beam	67	18c(+3–4 rings losts)	1520	1568	1586
BRC-C02	West head beam	62	h/s	1504	1565	1565
BRC-C03	East head beam	98	--	----	----	----
BRC-C04	East post, frame D	98	--	1393	----	1490
BRC-C05	East post, frame C	152	32c(+3–4 rings lost)	1435	1554	1586
BRC-C06	West post, frame C	60	--	1464	----	1523
BRC-C07	West post, frame B	118	--	1442	----	1559
BRC-C08	East post, frame B	NM	--	----	----	----
BRC-C09	West post, frame A	120	--	1454	1556	1573
BRC-C10	East post, frame A	44	--	1457	----	1500
BRC-C11	East brace, frame C	52	13c	1530	1568	1581
BRC-C12	East brace, frame D	62	18c	1519	1562	1580

*NM = not measured
**h/s = the heartwood/sapwood boundary ring is the last-measured ring on the sample
c(+x rings lost) = complete sapwood on timber, all or part lost during the sampling process with estimated number of lost rings (when known) in brackets

Table 2: Results of the cross-matching of site sequence BRCCSQ01 and relevant reference chronologies when the first-measured ring date is AD 1504 and the last-measured ring date is AD 1586

Reference chronology	*t*-value	Span of chronology	Reference
Dimple Farm, Matlock, Derbyshire	7.2	AD 1497–1593	Howard *et al* 1996a
Sinai Park, Staffordshire	6.9	AD 1227–1750	Tyers 1997
Church of St Nicholas, Bringhurst. Leicestershire	6.2	AD 1502–1687	Arnold *et al* 2005
White Tower, Tower of London, London	6.2	AD 1463–1616	Miles 2007
Newnham Hall Farm House, Oxfordshire	6.2	AD 1412–1614	Arnold and Howard 2006 unpubl)
Colston Bassett Church, Nottinghamshire	6.1	AD 1465–1609	Howard *et al* 1995a
Bodleian Library, Oxfordshire	6.1	AD 1395–1610	Miles and Worthington 1999

Table 3: Results of the cross-matching of site sequence BRCCSQ02 and relevant reference chronologies when the first-measured ring date is AD 1393 and the last-measured ring date is AD 1586

Reference chronology	*t*-value	Span of chronology	Reference
Ordsall Hall, Salford, Greater Manchester	8.0	AD 1385–1512	Howard *et al* 1994
Church Farm, Thope in the Glebe, Nottinghamshire	7.2	AD 1422–1521	Esling *et al* 1989
Offerton Hall, Offerton, Derbyshire	7.2	AD 1401–1592	Howard *et al* 1995b
Wakelyn Old Hall, Hilton, Derbyshire	7.1	AD 1415–1573	Arnold *et al* 2008
Master House, Saltisford, Warwickshire	7.1	AD 1412–1499	Howard *et al* 1996b
The Gables, Little Carlton, Nottinghamshire	6.9	AD 1389–1516	Howard *et al* 1986
Tithe Barn, Bolton Abbey, West Yorkshire	6.6	AD 1350–1518	Arnold *et al* 2015

Figure 1: Map to show the general location of Bramcote, circled (based on the Ordnance Survey map with permission of the Controller of Her Majesty's Stationery Office, ©Crown Copyright

Figure 2: Map to show the location of the Old Church, Bramcote, arrowed (based on the Ordnance Survey map with permission of the Controller of Her Majesty's Stationery Office, ©Crown Copyright)

Figure 3: Truss from the treble pit

Figure 4: Later transom brace in treble pit

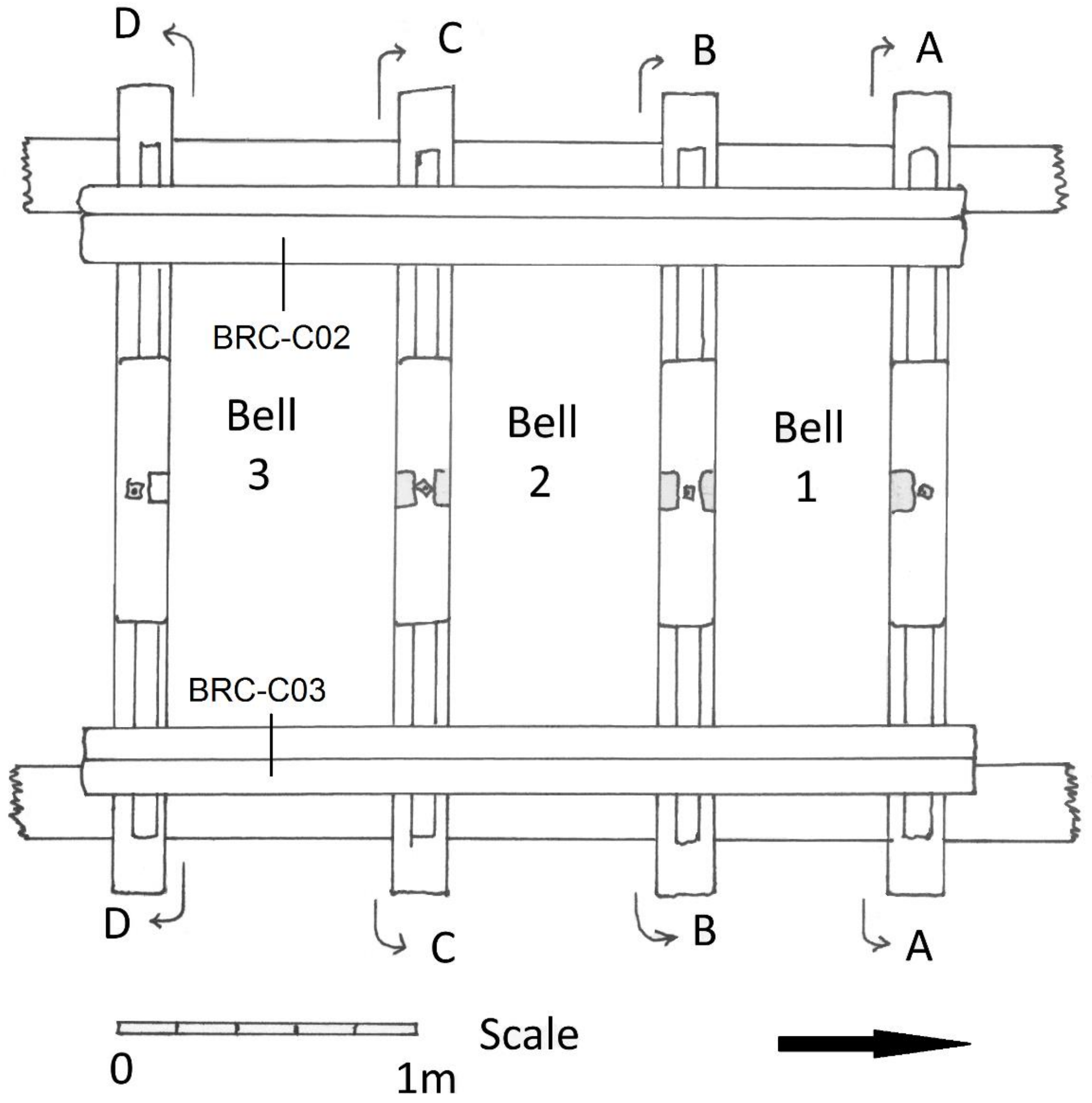

Figure 5: Plan of bellframe, showing truss labelling and the location of samples BRC-C01 and BRC-C03 (George Dawson)

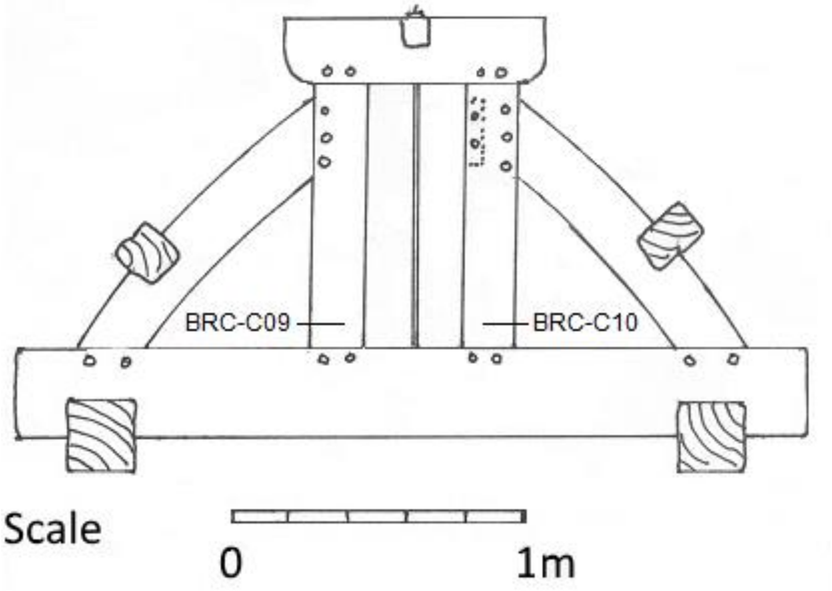

Figure 6: Truss A, showing the location of samples BRC-C09 and BRC-C10 (George Dawson)

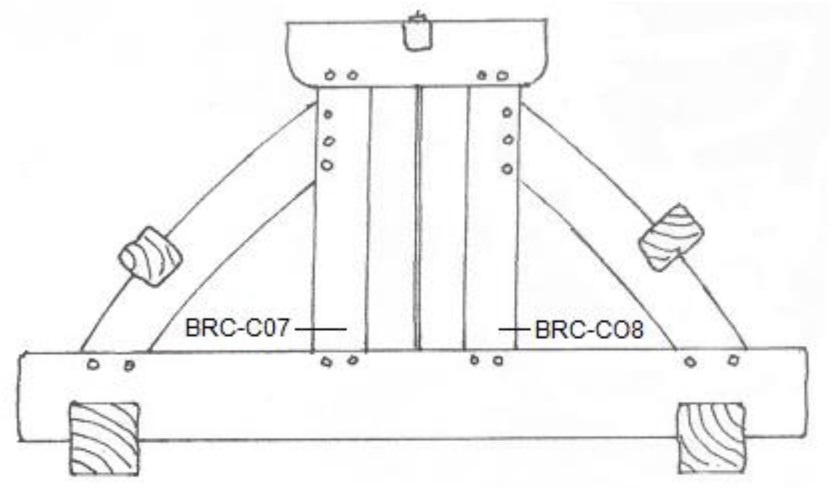

Figure 7: Truss B, showing the location of samples BRC-C07 and BRC-C08 (George Dawson)

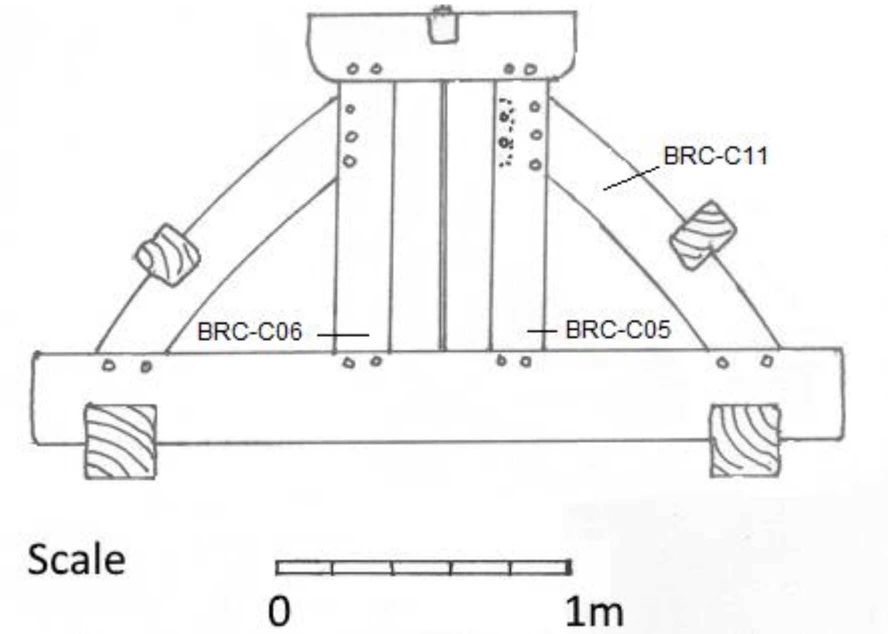

Figure 8: Truss C. showing the location of samples BRC-C05, BRC-C06, and BRC-C11 (George Dawson)

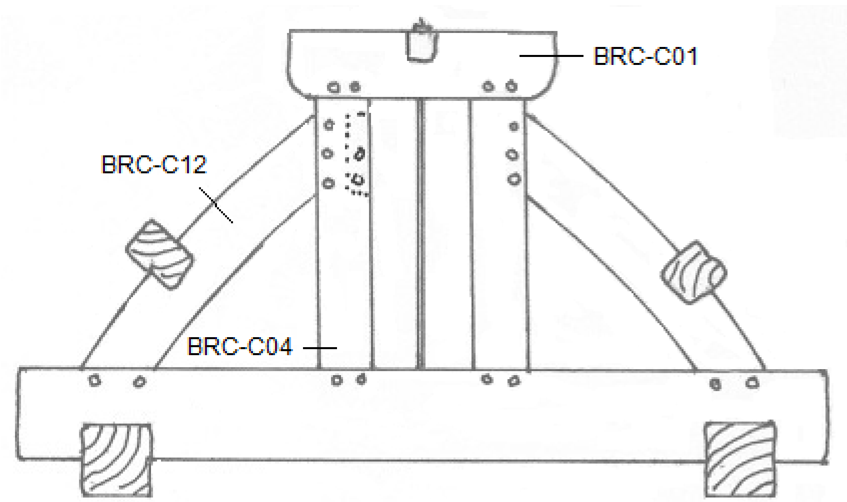

Figure 9: Truss D, showing the location of samples BRC-C01, BRC-C04, and BRC-C12 (George Dawson)

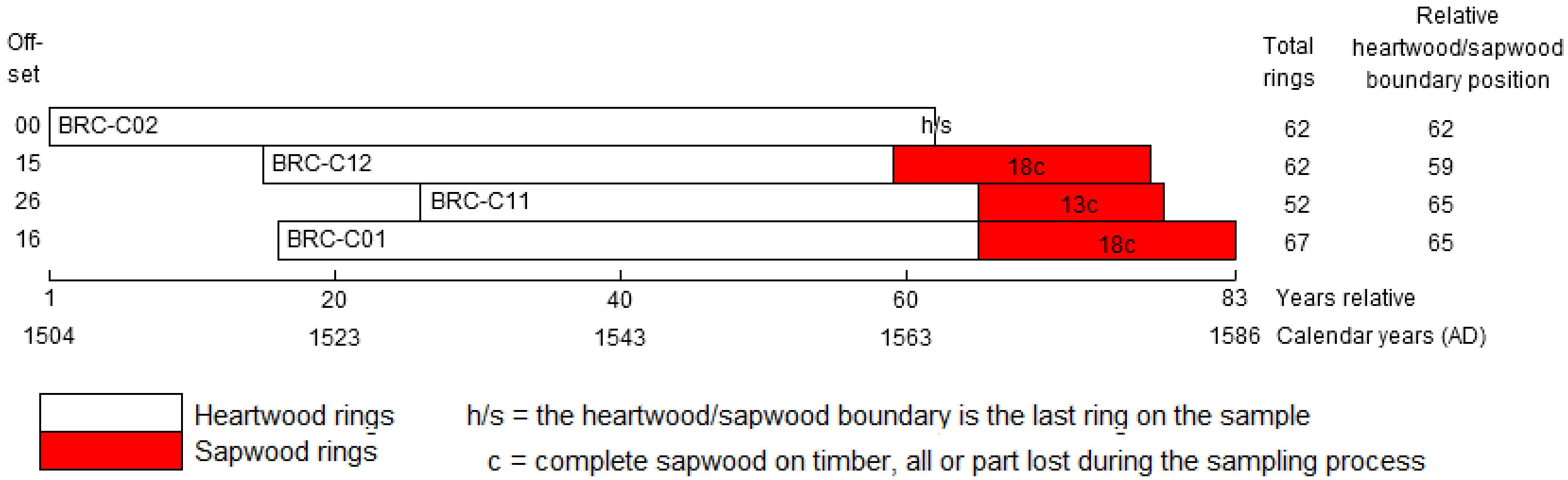

Figure 10: Bar diagram of samples in site sequence BRCCSQ01

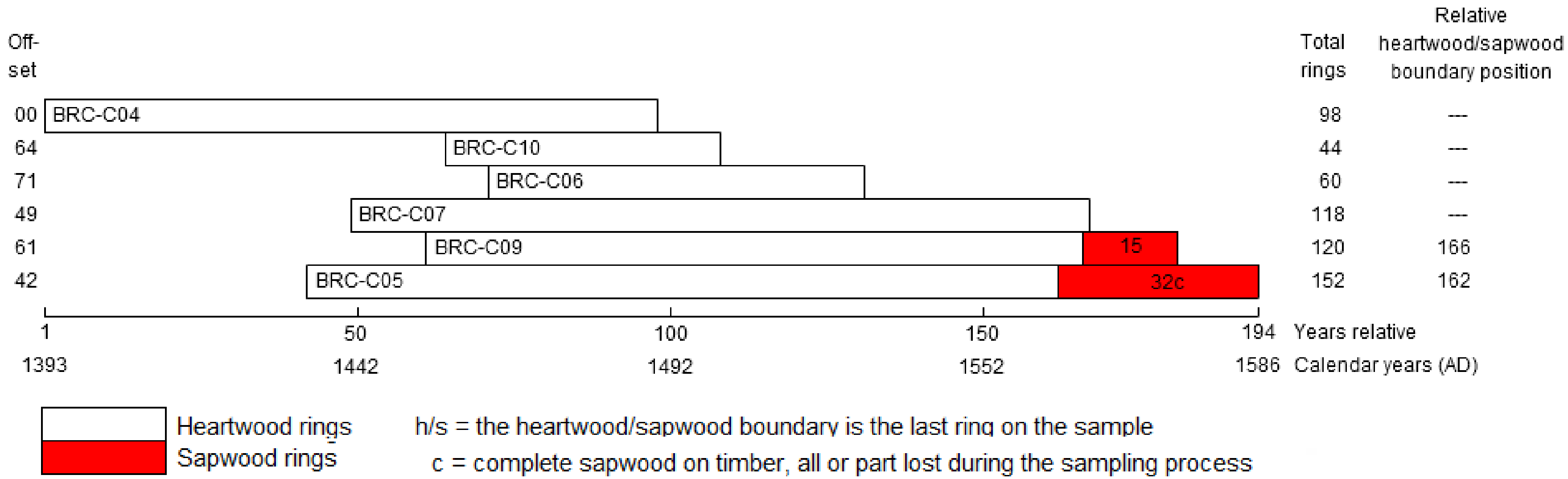

Figure 11: Bar diagram of samples in site sequence BRCCSQ02

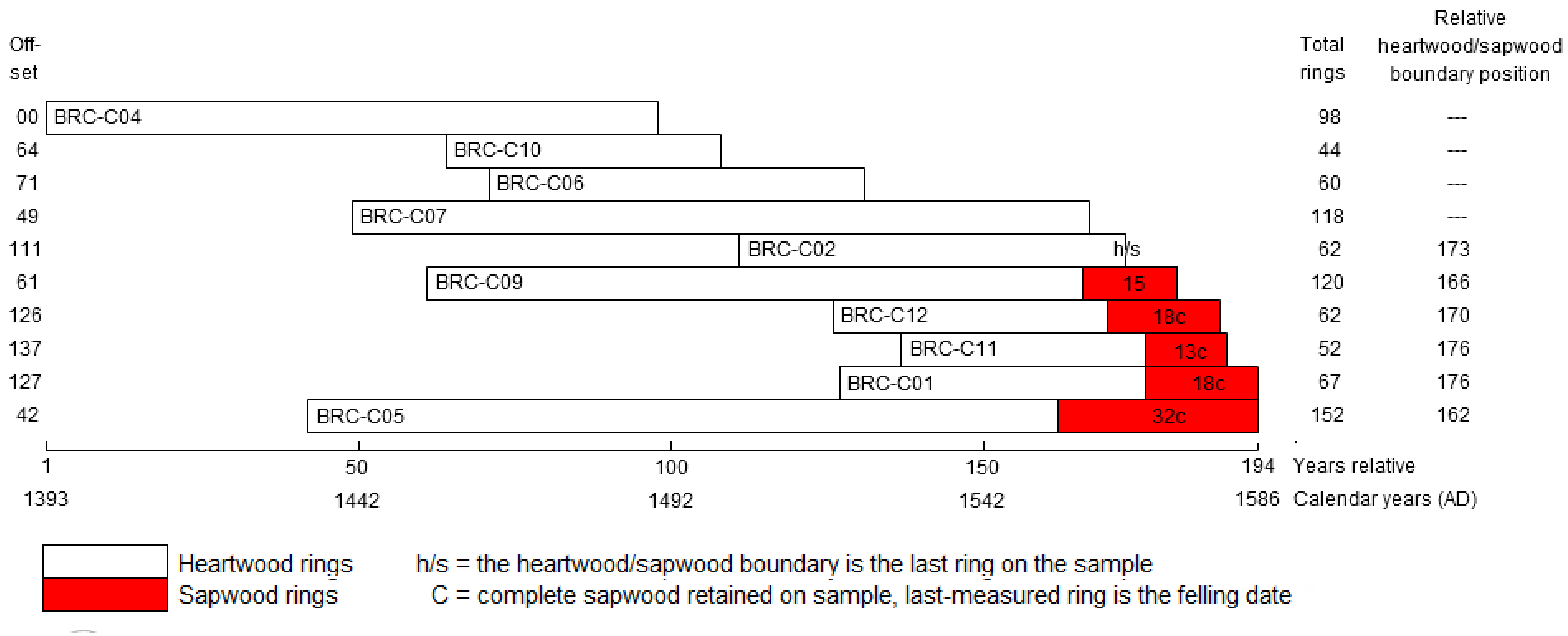

Figure 12: Bar diagram of all dated samples

DATA OF MEASURED SAMPLES

Measurements in 0.01mm units

BRC-C01A 40
481 401 514 392 498 534 320 523 426 410 407 292 230 173 230 205 168 200 285 301
273 327 250 299 258 263 258 269 312 220 262 270 257 244 220 229 224 171 233 236
BRC-C01B 47
270 309 203 244 329 375 560 474 397 347 258 414 472 449 423 441 270 388 498 435
433 443 353 423 358 279 346 247 459 266 329 314 221 195 194 318 379 233 390 542
485 356 453 415 453 388 326
BRC-C01C 40
209 297 266 315 414 251 244 188 284 305 178 348 591 463 410 373 343 362 213 269
188 185 139 113 132 122 108 89 97 112 146 111 163 209 137 120 127 131 85 304
BRC-C02A 62
262 226 194 216 196 211 161 283 286 266 238 319 410 262 381 388 275 234 182 180
263 161 226 226 217 333 286 478 381 217 273 289 255 195 186 194 298 205 137 208
145 153 170 137 189 166 191 264 179 151 157 247 246 201 247 203 245 213 253 240
248 238
BRC-C02B 62
262 229 187 201 184 209 161 266 288 276 233 326 425 255 389 374 282 233 185 186
217 149 216 215 224 353 281 510 368 221 267 295 255 199 172 185 262 217 140 217
136 142 176 130 190 170 197 262 188 143 153 273 244 195 237 195 262 205 269 263
247 260
BRC-C03A 98
158 136 148 115 134 164 139 187 170 173 139 183 140 146 135 119 144 125 121 139
108 142 157 124 110 146 137 125 136 108 85 61 51 53 47 42 37 36 38 31
27 36 40 39 30 45 37 46 37 30 31 31 18 31 33 43 50 86 60 48
44 47 61 60 59 73 90 71 72 116 108 97 82 71 130 180 158 275 205 192
193 241 236 226 340 440 435 322 242 217 166 217 254 300 321 111 130 110
BRC-C03B 98
162 135 149 119 135 166 133 186 168 168 135 179 145 142 140 114 145 119 129 143
124 124 153 106 127 125 136 108 119 122 91 60 49 46 48 48 36 36 36 38
34 31 40 36 35 39 41 39 40 31 34 28 22 25 30 49 50 84 66 45
41 47 63 61 53 81 90 71 69 117 104 99 75 73 134 176 161 271 201 204
191 248 238 230 326 471 430 328 244 217 173 215 267 281 319 104 122 118
BRC-C04A 98
247 262 260 238 234 284 241 229 211 245 297 269 222 228 132 148 242 242 176 221
196 160 124 134 198 248 171 244 124 116 134 170 169 172 158 135 155 147 152 163
116 139 110 102 102 95 76 120 114 131 146 154 131 62 98 116 134 139 133 108
102 124 127 131 98 80 81 79 88 100 118 102 136 281 363 453 381 288 309 311
241 272 394 366 253 250 363 283 325 308 323 212 242 220 337 280 178 191
BRC-C04B 98
255 264 255 244 238 270 237 223 211 234 276 303 263 226 167 137 232 238 174 209
192 164 115 137 195 245 169 247 127 115 130 175 175 175 149 141 149 139 155 168
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96 117 122 124 110 73 70 75 98 100 118 106 134 301 361 456 379 282 326 291
230 268 403 379 255 229 348 279 330 316 309 216 220 216 341 294 178 191
BRC-C05A 152
176 249 232 230 262 320 289 301 328 340 253 236 195 194 204 245 330 294 273 366
259 264 254 198 212 200 233 237 261 212 204 217 191 208 134 124 162 178 222 133

115 104 86 71 85 114 138 139 174 116 113 108 122 102 80 95 68 57 66 66
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42 44 37 47 71 98 118 62 62 73 151 151
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211 251 238 224 269 311 291 298 320 357 259 246 196 187 205 253 325 292 264 342
259 267 258 201 209 201 230 234 262 207 195 228 198 209 130 120 166 177 211 134
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47 41 31 51 70 104 112 62 59 74 144 140
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41 37 45 73 49 52 44 40 42 47 55 35 48 34 36 61 51 58 55 72
74 47 37 28 35 49 40 58 55 62 60 57 67 119 161 165 172 125 213 237
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108 146 114 114 127 127 138 152 146 153 153 152 144 213 201 170 193 137 172 178
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94 83 84 80 111 100 100 108 111 89 104 75 102 95 102 95 112 92 95 99
BRC-C09B 120
229 275 267 229 211 187 193 228 288 219 230 230 224 190 169 115 135 171 130 157
104 144 117 115 123 133 137 158 147 153 146 159 139 221 191 178 197 139 171 170
155 175 162 183 157 141 147 120 112 113 96 130 124 84 94 138 106 90 104 100
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61 87 71 90 90 116 125 102 75 89 98 127 129 115 114 118 152 127 127 130
102 91 78 82 114 100 99 108 104 99 100 72 96 97 119 91 97 106 100 108
BRC-C10A 44
137 83 88 108 121 114 186 183 267 510 494 539 523 370 371 371 300 384 451 484

335 298 611 391 444 501 435 266 384 334 585 410 276 238 170 154 182 183 356 398
285 226 176 355
BRC-C10B 44
150 84 86 106 114 115 192 181 302 477 480 538 519 377 363 361 296 376 467 483
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BRC-C11A 52
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191 185 132 148 124 157 125 123 106 156 153 171
BRC-C11B 52
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257 253 205 184 168 288 267 248 299 321 328 255 279 259 230 267 199 186 200 167
175 188 146 150 111 152 139 118 111 149 159 177
BRC-C12A 62
142 146 149 167 189 287 173 321 222 216 266 168 332 253 176 164 188 131 108 116
102 106 72 77 75 77 79 99 87 120 95 100 104 85 65 83 149 155 123 217
224 200 163 200 205 230 164 124 104 100 75 84 92 65 96 82 79 70 67 54
74 83
BRC-C12B 62
149 147 153 163 181 279 174 304 223 217 255 163 346 251 172 156 192 123 122 108
90 93 79 75 74 85 70 99 78 129 112 102 108 85 66 89 143 136 150 191
223 203 171 192 200 220 162 125 99 108 85 80 79 84 179 84 69 72 44 79
88 112